A few questions on the content of the previous lecture

slido

The Iowa Gambling Task captures the influence of ... on ... processes.

ⓘ Start presenting to display the poll results on this slide.

slido

To study the reactivity of the autonomic nervous system to emotional stimuli, we can use ...

ⓘ Start presenting to display the poll results on this slide.

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We can characterize emotions according to ... and ...

ⓘ Start presenting to display the poll results on this slide.

Social cognition

Dr. Lavinia Carmen Uscătescu

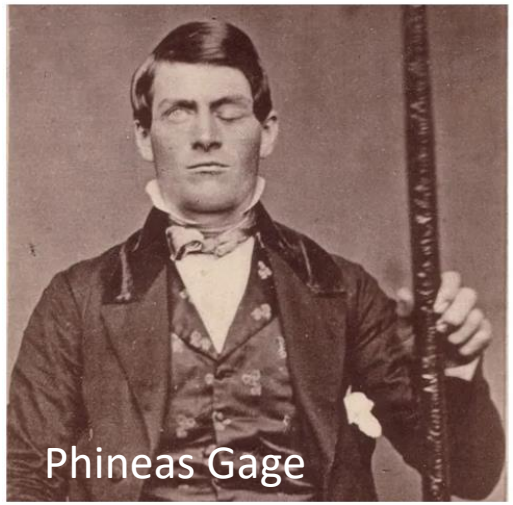
April 29th , 2024

Outline

1. Brief history of social neuroscience
2. Face perception
3. Simulation theory
4. Autism
5. Psychopathy

Brief history of social neuroscience

Acquired social behavior problems following **brain damage**


Phineas Gage

"He is fitful, irreverent, indulging at times in the grossest profanity, which was not previously his custom," — Dr. Harlow (1848)

Behav Brain Res. 1990 Dec 14;41(2):81-94. doi: 10.1016/0166-4328(90)90144-4.

Individuals with sociopathic behavior caused by frontal damage fail to respond autonomically to social stimuli

A R Damasio [1], D Tranel, H Damasio

Affiliations + expand

PMID: 2288668 DOI: 10.1016/0166-4328(90)90144-4

Following damage to ventromedial frontal cortices, adults with previously normal personalities develop defects in decision-making and planning that are especially revealed in an abnormal social conduct. The defect repeatedly leads to negative personal consequences. The physiopathology of this disorder is an enigma. We propose that the defect is due to an inability to activate somatic states linked to punishment and reward, that were previously experienced in association with specific social situations, and that must be reactivated in connection with anticipated *outcomes* of response options. During the processing that follows the perception of a social event, the experience of certain anticipated outcomes of response options would be marked by the reactivation of an appropriate somatic state. Failure to reactivate pertinent *somatic markers* would deprive the individual of an automatic device to signal ultimately deleterious consequences relative to responses that might nevertheless bring immediate reward (or, alternatively, signal ultimately advantageous outcomes relative to responses that might bring immediate pain). As an example, activation of somatic markers would (1) force attention to future negative consequences, permitting conscious suppression of the responses leading to them and deliberate selection of biologically advantageous responses, and (2) trigger non-conscious inhibition of response states by engagement of subcortical neurotransmitter systems linked to appetitive behaviors. An investigation of this theory in patients with frontal damage reveals that their autonomic responses to socially meaningful stimuli are indeed abnormal, suggesting that such stimuli fail to activate somatic states at the most basic level. On the contrary, elementary unconditioned stimuli (e.g. a loud noise) produce normal autonomic responses.

https://pubmed.ncbi.nlm.nih.gov/2288668/

*Remember the **somatic marker hypothesis** of **Antoine Bechara** and **Antonio Damasio** (from the previous lecture on Emotions).*

Developmental variations of social behavior

This book is the product of our collaboration during a late stage in our working lives. When we started long ago, we were working on very different topics and were mainly interested in the neuropsychology of clinical groups. One of us was working on autism (Uta Frith, 1989), and the other on schizophrenia (Chris Frith, 1992). We came to realize that both these conditions are associated first and foremost with troubling problems with social communication. We have attempted to explain them by exploring the cognitive mechanism that underlies mentalizing (the ability to use mental states to predict what an agent is going to do). We first wrote about this together thirty years ago (Frith and Frith, 1991). Gradually, we increased our collaboration, relishing the use of brain imaging that allowed us to probe the neurophysiological basis of this mechanism. This confirmed our belief that the most exciting topic to study is social cognition (Frith and Frith, 1999). It still excites us, and we hope it will also excite our readers.

Frith & Frith, (2023), pp. 2-3

Chris and Uta Frith

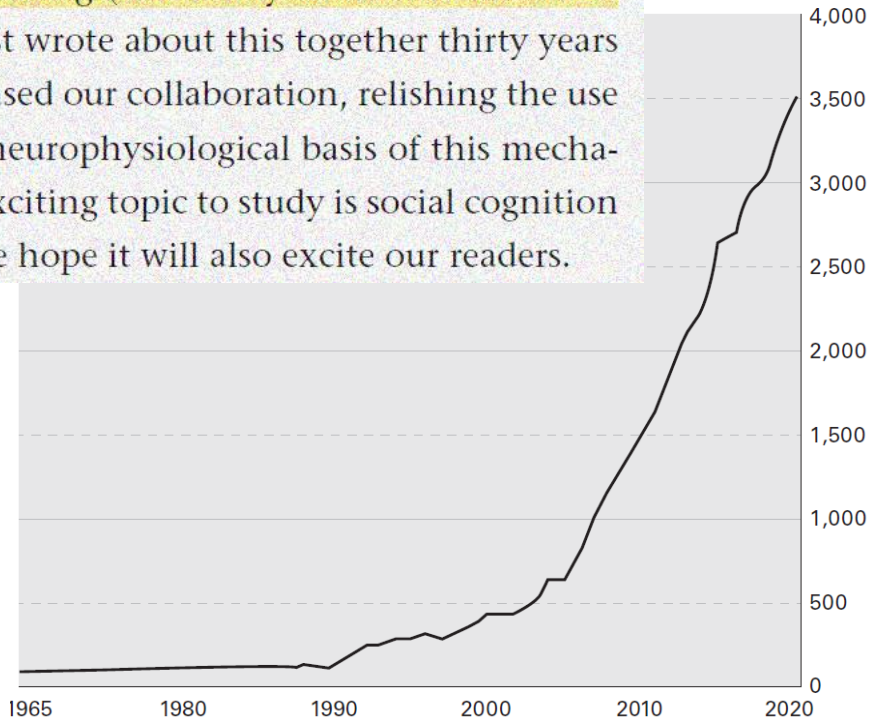
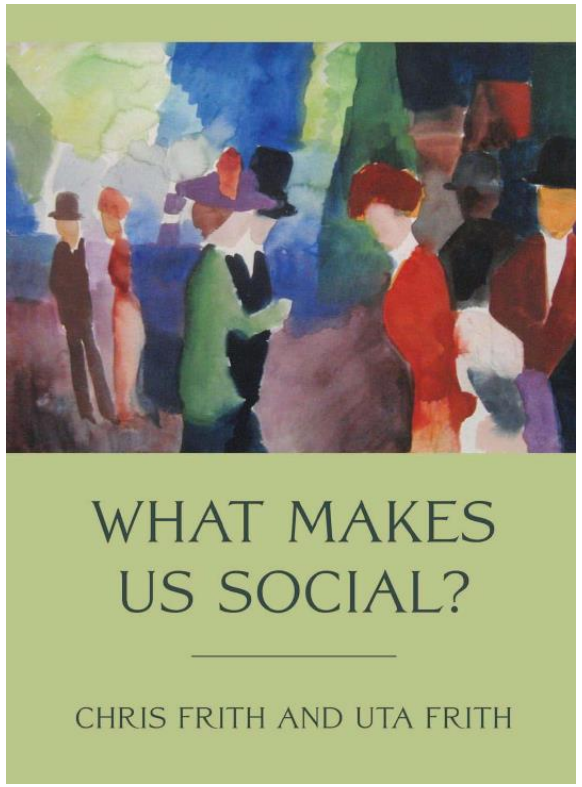


Figure 1.1

Number of papers on the topic of social cognition published per year between 1965 and 2020 (the time span that coincides with our life in research)



The first mention of **cognitive neuroscience**

Review > Am Psychol. 1992 Aug;47(8):1019-28. doi: 10.1037//0003-066x.47.8.1019.

Social psychological contributions to the decade of the brain. Doctrine of multilevel analysis

J T Cacioppo [1], G G Berntson

Affiliations + expand

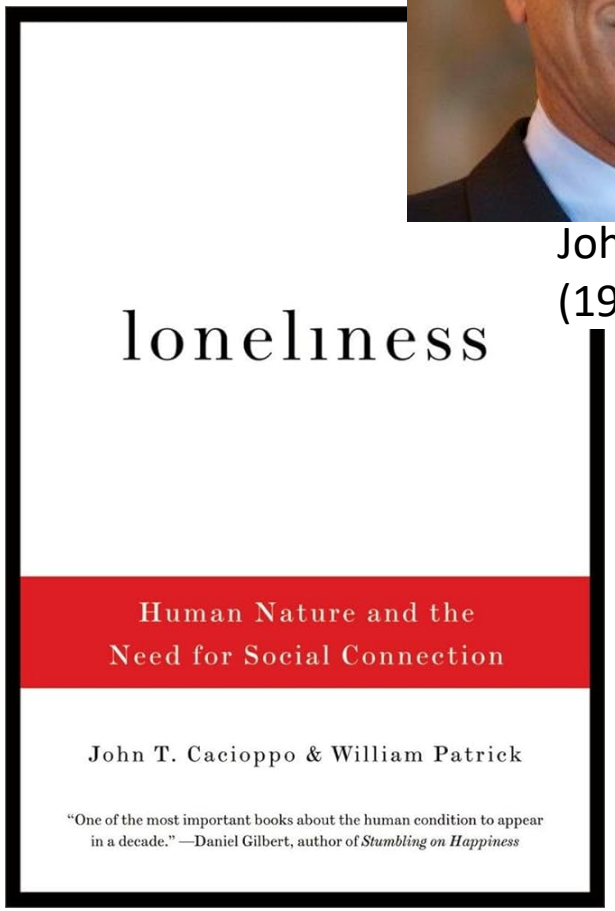
PMID: 1510329 DOI: 10.1037//0003-066x.47.8.1019

Abstract

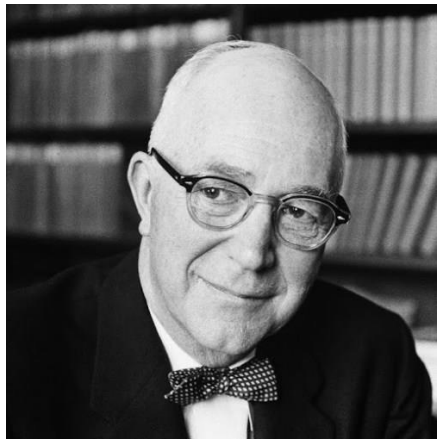
The 1990s were declared by Congress to be the "decade of the brain." This declaration is important to all psychologists, not only neuroscientists, because with this declaration come expectations of the cognitive and behavioral sciences generally and because the brain does not exist in isolation but rather is a fundamental component of developing and aging individuals who themselves are mere actors in the larger theater of life. This article examines the importance of a multilevel, integrative approach to the study of mental and behavioral phenomena in the decade of the brain, reviews how this approach highlights the synergistic relationship between theoretical and clinically relevant research, and illustrates how this approach can foster the transition from microtheories to general psychological theories.

https://pubmed.ncbi.nlm.nih.gov/1510329/

John Cacioppo
(1951 – 2018)



Gordon Allport – the father of personality psychology



Gordon Allport
(1897 – 1967)

social psychology

"an attempt to **understand** and **explain** **how** the **thoughts**, **feelings**, and **behaviours** of individuals are **influenced** by the actual, imagined, or implied **presence** of **others**" (Allport, 1954)

social neuroscience

an attempt to **understand** and **explain**, ***using neural mechanisms***, **how** the **thoughts**, **feelings**, and **behaviours** of individuals are **influenced** by the actual, imagined, or implied **presence** of **others** (Ward, 2017, p. 16)

2006 **First journals dedicated to social neuroscience**

Social Neuroscience
https://www.tandfonline.com/journals/psns20

Social, Cognitive and Affective Neuroscience (SCAN)
https://academic.oup.com/scan

First professional societies dedicated to social neuroscience

2008 The Society for Social and Affective Neuroscience (SANS; www.socialaffectiveneuro.org)

2010 Society for Social Neuroscience (S4SN; www.s4sn.org)

Face perception

The **cognitive model** of face recognition of **Bruce** and **Young** (1986)

British Journal of Psychology (1986), 77, 305–327 *Printed in Great Britain*

Understanding face recognition

Vicki Bruce and **Andy Young**

https://bpspsychub.onlinelibrary.wiley.com/doi/abs/10.1111/j.2044-8295.1986.tb02199.x

1. s**tructural** encoding – **physical** attributes;
2. face **familiarity** – by comparing the facial stimulus to a stored representation of all familiar faces, called **face recognition unit**;
3. once recognition occurs, additional information may be triggered (e.g., name) - **person identity node;**
4. unfamiliar faces are processed via a different route called **directed visual processing;**
5. other processing pathways apply to both familiar and unfamiliar faces, e.g., for detecting **emotional expression**.

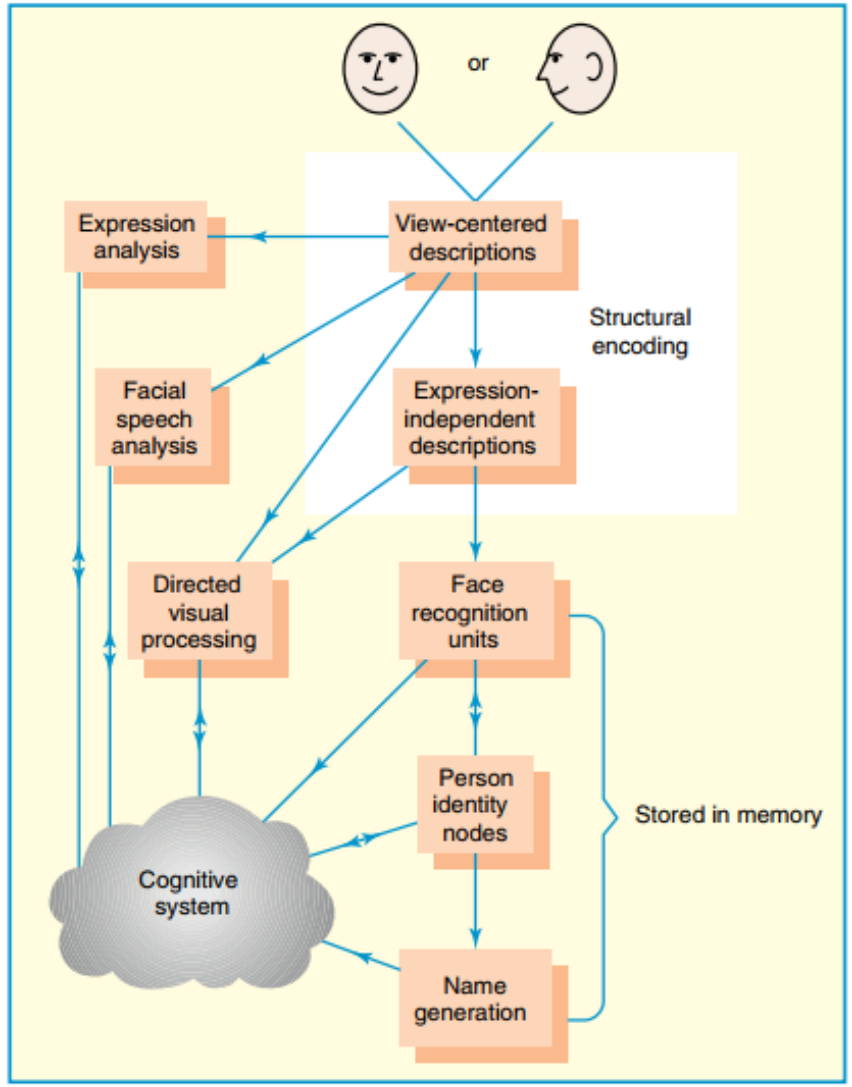


Figure 5.2 The Bruce and Young (1986) model of face processing postulates a number of separate mechanisms that reflect the different goals of the perceiver, including: recognizing a familiar face; recognizing a facial expression; and matching two images of an unfamiliar face.

Ward, (2017), p. 143

Eye Brain. 2016; 8: 165–175.
Published online 2016 Sep 26. doi: 10.2147/EB.S92838

Prosopagnosia: current perspectives

Sherryse L Corrow,[1,2] Kirsten A Dalrymple,[3] and Jason JS Barton[1,2]

▸ Author information ▸ Copyright and License information Disclaimer

Abstract

Prosopagnosia is a selective visual agnosia characterized by the inability to recognize the identity of faces. There are both acquired forms secondary to brain damage and developmental forms without obvious structural lesions. In this review, we first discuss the diagnosis of acquired and developmental prosopagnosia, and the challenges present in the latter case. Second, we discuss the evidence regarding the selectivity of the prosopagnosic defect, particularly in relation to the recognition of other objects, written words (another visual object category requiring high expertise), and voices. Third, we summarize recent findings about the structural and functional basis of prosopagnosia from studies using magnetic resonance imaging, functional magnetic resonance imaging, and event-related potentials. Finally, we discuss recent attempts at rehabilitation of face recognition in prosopagnosia.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5398751/

Prosopagnosia offers support for the cognitive model of face recognition, since this impairment is not due to more general problems with vision, object recognition, or memory. Within the model, prosopagnosia would occur at the **face recognition unit** level.

https://www.youtube.com/watch?v=vwCrxomPbtY

Neural basis of face perception

ventral stream ("what")

enables object identification

dorsal stream ("where)

enables the processing of an object's location

Trends in Neurosciences

Volume 6, 1983, Pages 414-417

Review

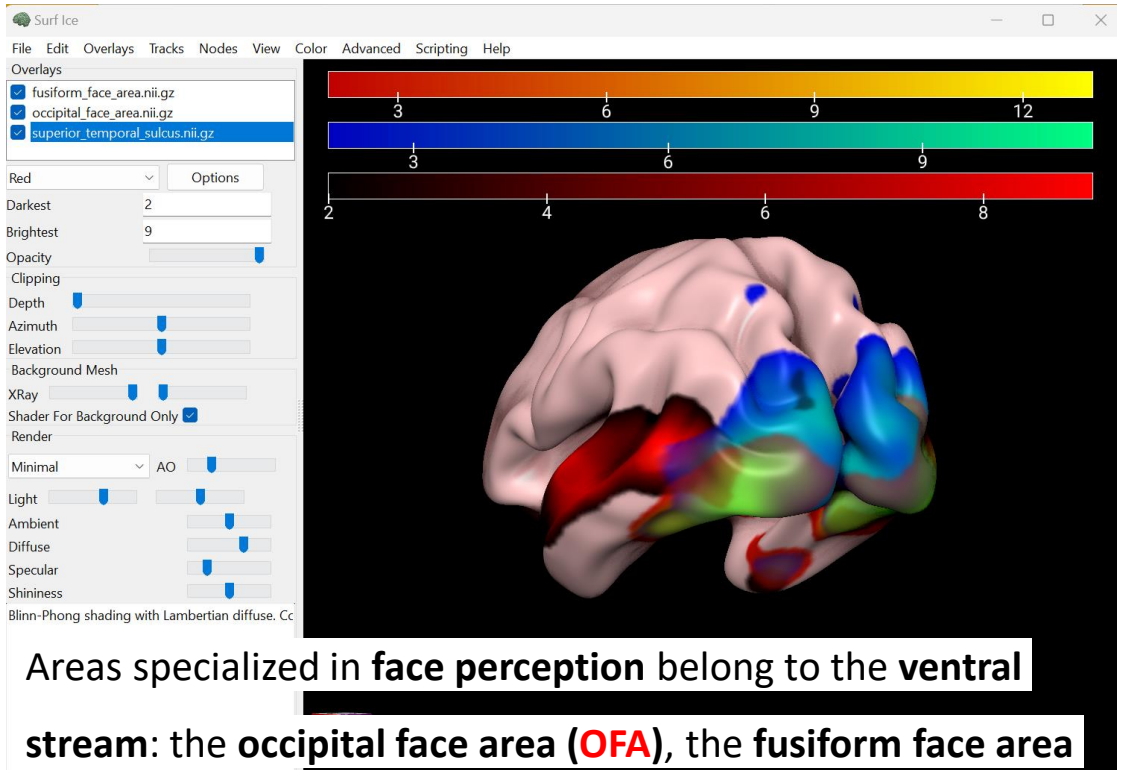
Object vision and spatial vision: two cortical pathways

Mortimer Mishkin, Leslie G. Ungerleider, Kathleen A. Macko

Abstract

Evidence is reviewed indicating that striate cortex in the monkey is the source of two multisynaptic corticocortical pathways. One courses ventrally, interconnecting the striate, prestriate, and inferior temporal areas, and enables the visual identification of objects. The other runs dorsally, interconnecting the striate, prestriate, and inferior parietal areas, and allows instead the visual location of objects. How the information carried in these two separate pathways is reintegrated has become an important question for future research.

https://www.sciencedirect.com/science/article/pii/016622368390190X



Areas specialized in **face perception** belong to the **ventral stream**: the **occipital face area (OFA)**, the **fusiform face area (FFA),** and the **superior temporal sulcus (STS).**

The **neuroanatomically** inspired model of **Haxby**, **Hoffman**, and **Gobbini** (2000)

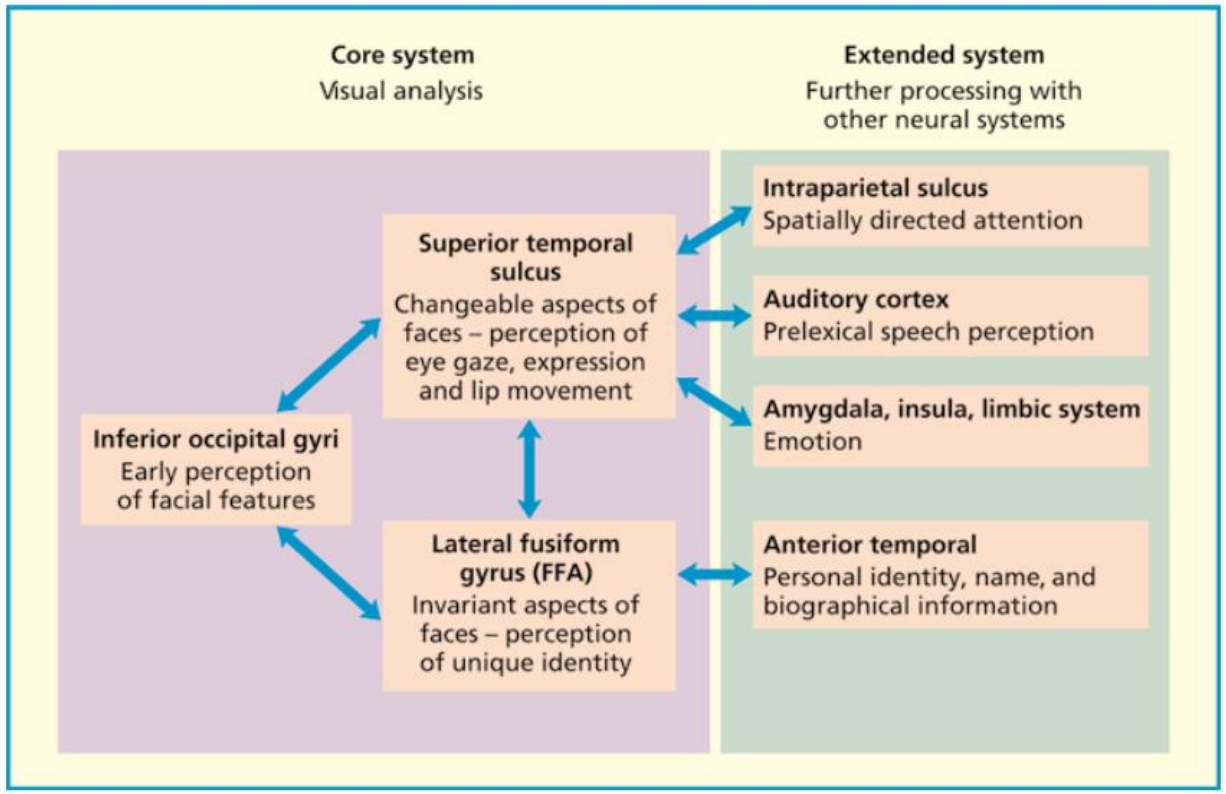


Figure 5.4 The model of Haxby et al. (2000) divides the neural substrates of face processing into a number of core mechanisms (relatively specialized for faces) and an extended system in which face processing makes contact with more general cognitive mechanisms (e.g. concerning emotion, language, action).

Ward, (2017), p. 145

Trends Cogn Sci. 2000 Jun;4(6):223-233. doi: 10.1016/s1364-6613(00)01482-0.

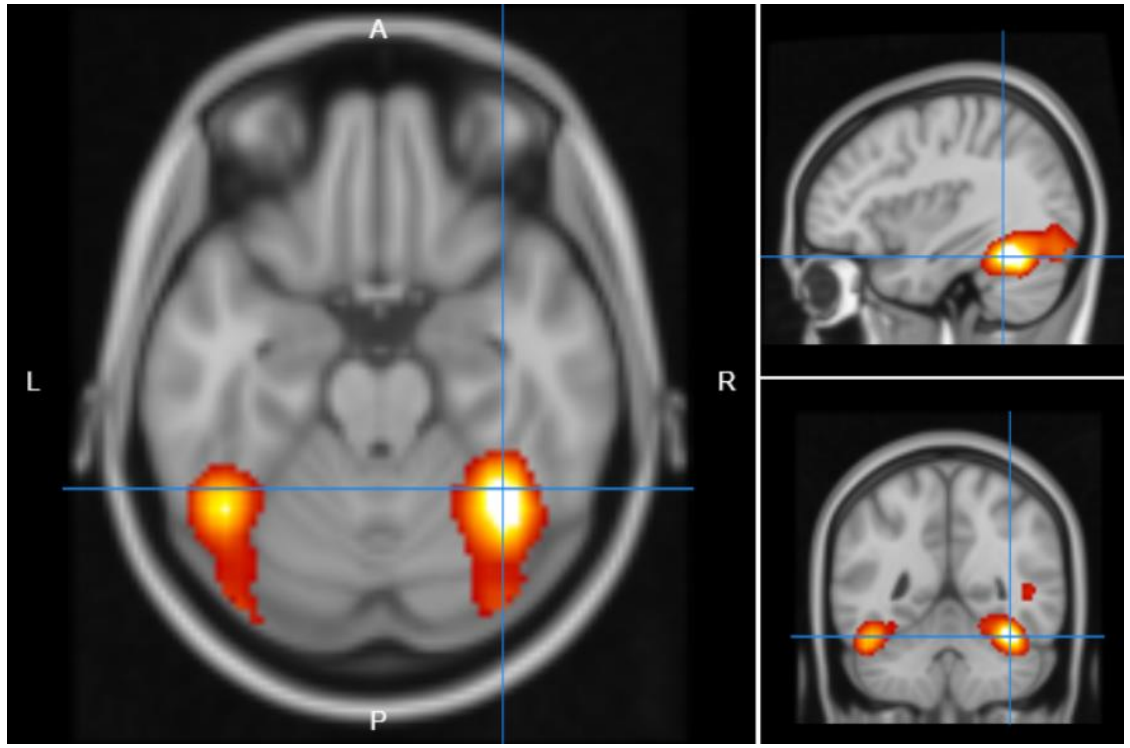
The distributed human neural system for face perception

JV Haxby [1], EA Hoffman, MI Gobbini

Face perception, perhaps the most highly developed visual skill in humans, is mediated by a distributed neural system in humans that is comprised of multiple, bilateral regions. We propose a model for the organization of this system that emphasizes a distinction between the representation of invariant and changeable aspects of faces. The representation of invariant aspects of faces underlies the recognition of individuals, whereas the representation of changeable aspects of faces, such as eye gaze, expression, and lip movement, underlies the perception of information that facilitates social communication. The model is also hierarchical insofar as it is divided into a core system and an extended system. The core system is comprised of occipitotemporal regions in extrastriate visual cortex that mediate the visual analysis of faces. In the core system, the representation of invariant aspects is mediated more by the face-responsive region in the fusiform gyrus, whereas the representation of changeable aspects is mediated more by the face-responsive region in the superior temporal sulcus. The extended system is comprised of regions from neural systems for other cognitive functions that can be recruited to act in concert with the regions in the core system to extract meaning from faces.

https://pubmed.ncbi.nlm.nih.gov/10827445/

Fusiform face area (FFA)



Relatively specialized for **faces** (not bodies or objects).

Important for computing **view invariant** facial identity.

Evidence for the selectivity of the FFA comes from the studies of **Nancy Kanwisher** and from cases of **acquired prosopagnosia.**

Case Reports › J Neuropsychol. 2008 Mar;2(1):197-225. doi: 10.1348/174866407x214172.

Structure and function in acquired prosopagnosia: lessons from a series of 10 patients with brain damage

Jason J S Barton [1]

https://pubmed.ncbi.nlm.nih.gov/19334311/

Philos Trans R Soc Lond B Biol Sci. 2006 Dec 29; 361(1476): 2109–2128.
Published online 2006 Nov 8. doi: 10.1098/rstb.2006.1934

The fusiform face area: a cortical region specialized for the perception of faces

Nancy Kanwisher[1,*] and Galit Yovel[2]

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1857737/

The *"Greebles"* of Gauthier et al., (1999)

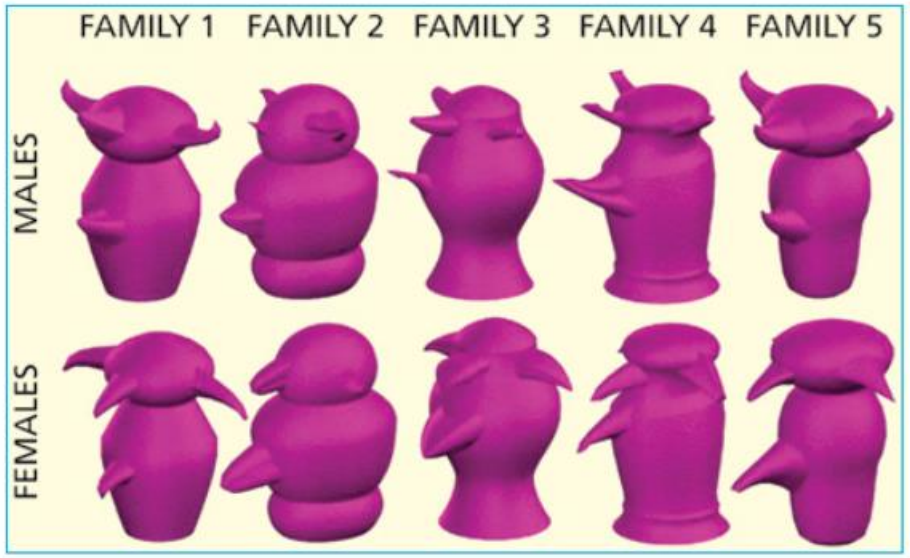


Figure 5.6 Greebles can be grouped into two genders and come from various families. To what extent does discriminating amongst Greebles resemble discriminating across faces? Images provided courtesy of Michael J. Tarr (Carnegie Mellon University, Pittsburgh, PA; see www.tarrlab.org).

Ward, (2017), p. 147

In contrast to Nancy Kanwisher, some authors have suggested that the FFA can become specialized in **within-category discriminations.**

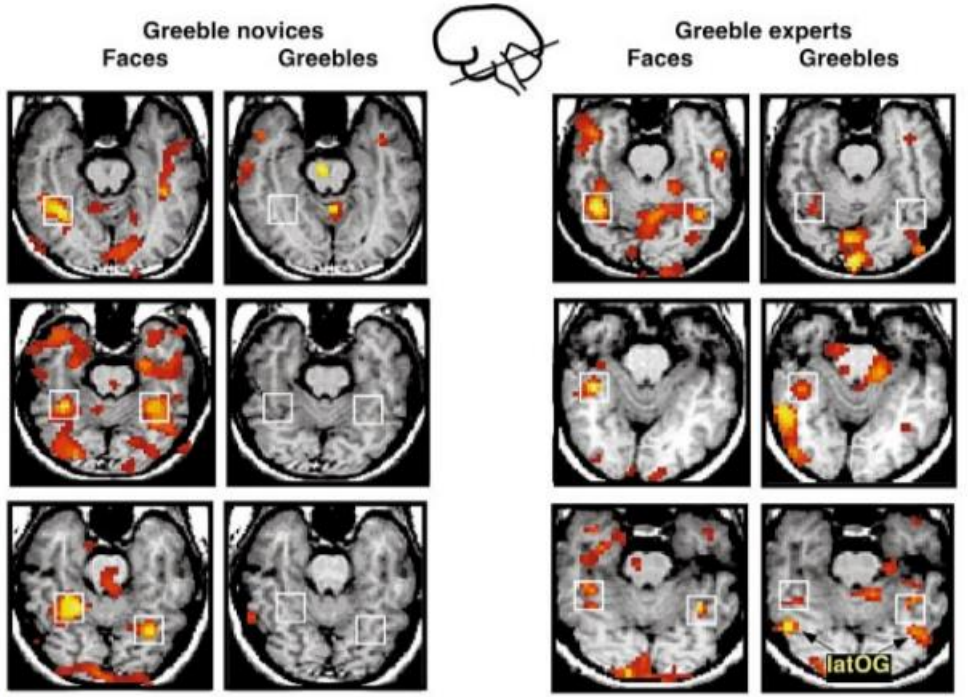


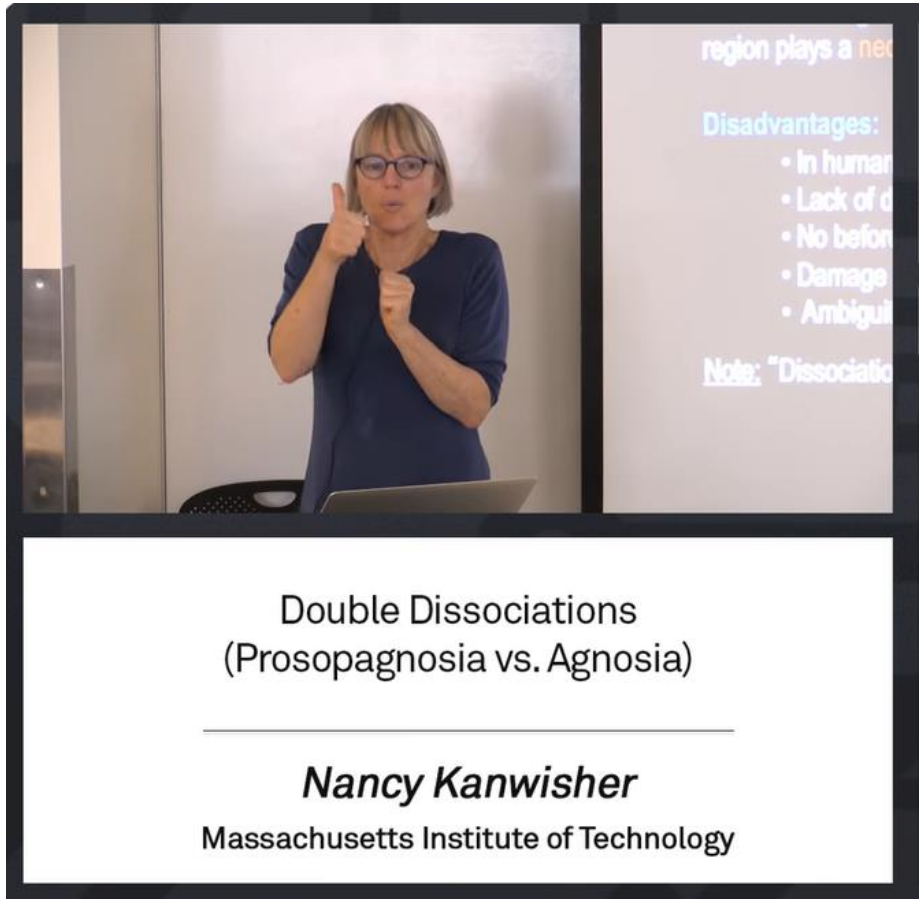
Fig. 4. Activation maps for three novices and three experts in the passive-viewing tasks with faces and greebles. A baseline of passive viewing of objects is used in both conditions, and only the voxels showing more activation for faces or greebles than objects are shown. Images are thresholded at an arbitrary value of $t = 0.75$. Note that we do not attribute any statistical meaning to individual subjects' t-values. The statistical significance of the effects is determined by their representation in the group sample. White squares, middle fusiform gyri ROI; arrows, lateral occipital gyrus foci for one expert (bottom right).

https://www.nature.com/articles/nn0699_568

Nevertheless, things are **not** so clear-cut (are they ever?!)

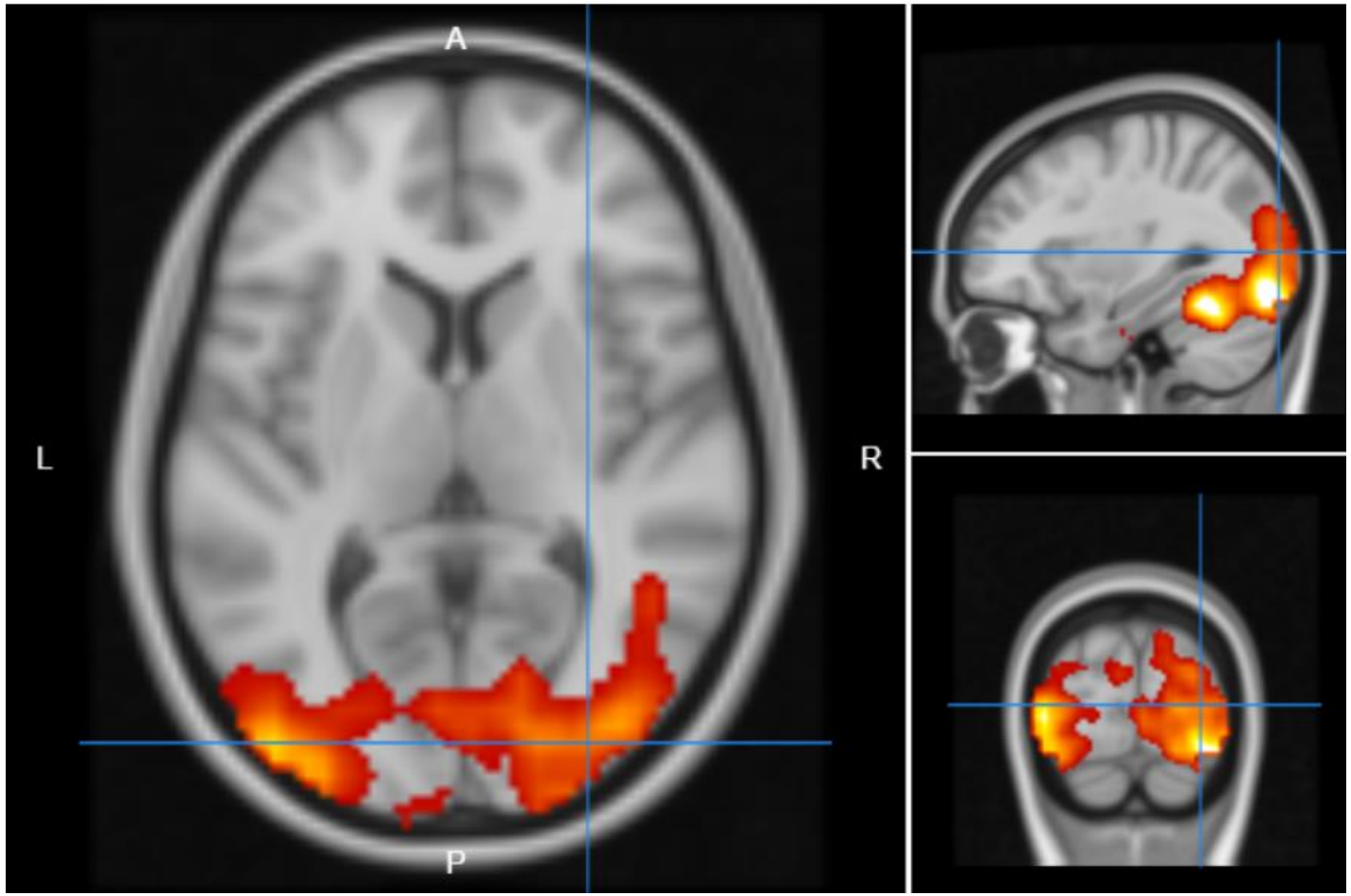
There is some evidence from prosopagnosia that supports the face specificity account against the visual expertise alternative. Sergent and Signoret (1992) reported a prosopagnosic patient, RM, who had a collection of over 5000 miniature cars. He was unable to identify any of 300 famous faces, or the face of himself or his wife, or match unfamiliar faces across viewpoints. Nevertheless, when shown 210 pictures of miniature cars he was able to give the company name, and for 172 he could give the model and approximate year of manufacture. This suggests that face perception and visual within-category expertise are not necessarily the same thing (see also McNeil & Warrington, 1993).

Ward, (2017), p. 147



https://www.youtube.com/watch?v=Dsi8zfJ5LKE

Occipital face area (OFA)



Early stage in perceptual analysis of faces; sends **inputs** to **fusiform** and **superior temporal regions**.

Relatively **specialized** for faces (not bodies or objects).

Codes the **physical aspects** of facial stimuli.

Neuroimage. Author manuscript; available in PMC 2010 Jan 15.

Published in final edited form as:

Neuroimage. 2009 Jan 15; 44(2): 569–580.

Published online 2008 Sep 25. doi: 10.1016/j.neuroimage.2008.09.011

The correlates of subjective perception of identity and expression in the face network: an fMRI adaptation study

Christopher J. Fox,[1,2] So Young Moon,[3] Giuseppe Iaria,[2] and Jason J.S. Barton[2]

Abstract

The recognition of facial identity and expression are distinct tasks, with current models hypothesizing anatomic segregation of processing within a face-processing network. Using fMRI adaptation and a region-of-interest approach, we assessed how the perception of identity and expression changes in morphed stimuli affected the signal within this network, by contrasting (a) changes that crossed categorical boundaries of identity or expression with those that did not, and (b) changes that subjects perceived as causing identity or expression to change, versus changes that they perceived as not affecting the category of identity or expression. The occipital face area (OFA) was sensitive to any structural change in a face, whether it was identity or expression, but its signal did not correlate with whether subjects perceived a change or not. Both the fusiform face area (FFA) and the posterior superior temporal sulcus (pSTS) showed release from adaptation when subjects perceived a change in either identity or expression, although in the pSTS this effect only occurred when subjects were explicitly attending to expression. The middle superior temporal sulcus (mSTS) showed release from adaptation for expression only, and the precuneus for identity only. The data support models where the OFA is involved in the early perception of facial structure. However, evidence for a functional overlap in the FFA and pSTS, with both identity and expression signals in both areas, argues against a complete independence of identity and expression processing in these regions of the core face-processing network.

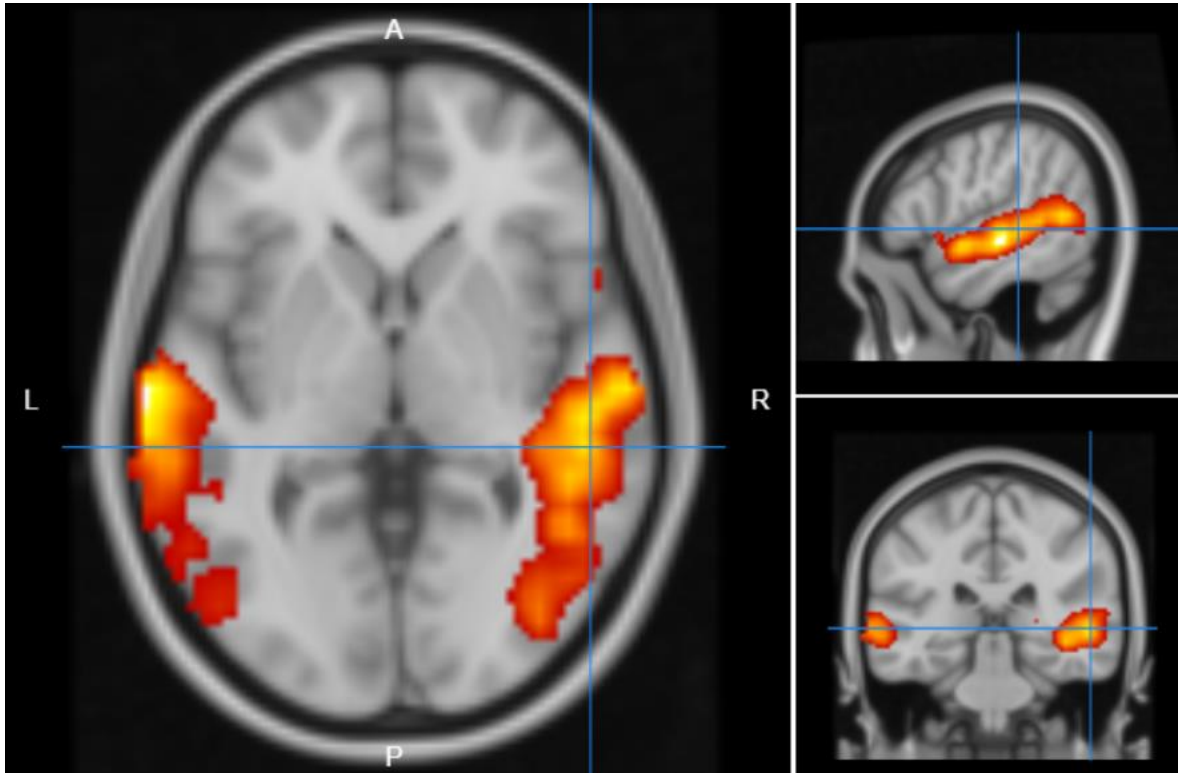
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2648406/

An **adaptation** (or **repetition suppression**) paradigm takes advantage of the effect that the signal in a (specialized) brain region is reduced when the *"same"* stimulus is repeatedly presented => the **repetition suppression effect.**

In this example, *same* can mean same *identity*, same *expression*, or *both*.

Superior temporal sulcus (STS)

Responds to **faces and bodies**. Important for action perception and dynamic stimuli (e.g. **lip movements**). **Integrates visual and auditory** information.



Neuroimage. 2001 Aug;14(2):427-38. doi: 10.1006/nimg.2001.0812.

Detection of audio-visual integration sites in humans by application of electrophysiological criteria to the BOLD effect

G A Calvert [1], P C Hansen, S D Iversen, M J Brammer

*Responds to both **seen** speech (i.e., facial lip-reading) and **heard speech**, and that the response is **greater** when the two **correspond** in terms of content and timing (Calvert et al., 2001).*
https://pubmed.ncbi.nlm.nih.gov/11467916/

Comparative Study > J Cogn Neurosci. 2005 Mar;17(3):377-91. doi: 10.1162/0898929053279586.

Integration of visual and auditory information by superior temporal sulcus neurons responsive to the sight of actions

Nick E Barraclough [1], Dengke Xiao, Chris I Baker, Mike W Oram, David I Perrett

*Single-cell recordings from monkeys show neurons that respond to both the **sight** and **sound** of certain actions such as **lip-smacking** or threat noises (Barraclough et al., 2005) .*
https://pubmed.ncbi.nlm.nih.gov/15813999/

Joint attention

Clinical Trial > Nat Neurosci. 2000 Jan;3(1):80-4. doi: 10.1038/71152.

Distinct representations of eye gaze and identity in the distributed human neural system for face perception

E A Hoffman [1], J V Haxby

Face perception requires representation of invariant aspects that underlie identity recognition as well as representation of changeable aspects, such as eye gaze and expression, that facilitate social communication. Using functional magnetic resonance imaging (fMRI), we investigated the perception of face identity and eye gaze in the human brain. Perception of face identity was mediated more by regions in the inferior occipital and fusiform gyri, and perception of eye gaze was mediated more by regions in the superior temporal sulci. Eye-gaze perception also seemed to recruit the spatial cognition system in the intraparietal sulcus to encode the direction of another's gaze and to focus attention in that direction.

https://pubmed.ncbi.nlm.nih.gov/10607399/

Biological motion

December 01 2017

A Causal Role of the Right Superior Temporal Sulcus in Emotion Recognition From Biological Motion

In Special Collection: CogNet

Rochelle A. Basil, Margaret L. Westwater, Martin Wiener, James C. Thompson

Check for updates

Author and Article Information

Open Mind (2017) 2 (1): 26–36.

https://doi.org/10.1162/opmi_a_00015 **Article history**

https://direct.mit.edu/opmi/article/2/1/26/2945/A-Causal-Role-of-the-Right-Superior-Temporal

> Neuroimage Clin. 2017 Jan 9:14:112-121. doi: 10.1016/j.nicl.2017.01.006. eCollection 2017.

Young adolescents with autism show abnormal joint attention network: A gaze contingent fMRI study

E Oberwelland [1], L Schilbach [2], I Barisic [3], S C Krall [4], K Vogeley [5], G R Fink [6], B Herpertz-Dahlmann [7], K Konrad [4], M Schulte-Rüther [1]

https://pubmed.ncbi.nlm.nih.gov/28180069/

Article | Open access | Published: 17 July 2017

Neural processing of biological motion in autism: An investigation of brain activity and effective connectivity

Kaat Alaerts, Stephan P. Swinnen & Nicole Wenderoth

https://www.nature.com/articles/s41598-017-05786-z

How does the brain

Enable

Mental states

knowledge, beliefs, feelings, intentions, and desires

Mentalizing

the process of inferring or attributing mental states to others

Simulation theory

Box 1 | The Lexicon of mental state attribution terms

Mentalizing

We defined 'mentalizing' as *"the ability to attribute mental states (e.g., knowledge, intentions, emotions, perception) to self and others"*. Ninety percent of our expert panel agreed with this definition. Most of the experts used "mentalizing" as a strict synonym of "theory of mind" (66%) and of "mindreading" (61%), to refer to the broad ability to attribute mental states to others. As only 13% of the expert panel originally voted to no longer use this term in favor of a synonym and 27% stated that they would favor this term, Mentalizing has ultimately been selected as the most generic term to use when addressing the ability to attribute mental states.

Theory of mind

Two main definitions of "theory of mind" currently co-exist in the literature and were accordingly listed by our experts. One of these definitions refers to the ability to attribute mental states (i.e. mentalizing), whereas the other refers to a theory-specific term for the hypothesis that thinking about other people's mental states involves a set of concepts and principles about how these concepts interact. We recommend using "theory of mind" exclusively to refer to its second meaning and define it as *"The use of folk psychological knowledge and heuristics (e.g., "mental states are correlated with behaviors", "mental states differ between agents") to think about one's own and other people's mental states"*. In this way, having a theory of mind would indicate one specific way (among multiple) to mentalize. 80% of the expert panel agreed with this definition. Importantly, this definition is congruent with the original use of "theory of mind" in ethology in which it was viewed as a theory that individuals hold and not as an ability[5].

Perspective-taking

We recommend defining perspective-taking as *"the process by which one represents others' mental states, by adopting their perspective"*. Based on this definition, perspective taking would refer to a specific form of mentalizing. Importantly, perspective-taking can refer to a spatial (e.g., "my colleague think that I am working as they can't see my screen") and a temporal perspective (e.g., "tomorrow my colleague will be disappointed, if I don't prepare the meeting now"). 82,5% of our panel agreed with this definition.

Empathy

The theoretical heterogeneity associated with the term "empathy" has been widely discussed recently[2,6,7]. This is also reflected in the heterogeneity of definitions that we received from the expert panel. To limit synonyms as much as possible, and thus to clarify theoretical elaborations, we recommend adopting the following definition when speaking of empathy in the context of mental state attribution: *"the ability to experience others' affective states, while maintaining the distinction from one's own affective states"*. Among our panel, 82.5% finally agreed with this definition. We recognize that the present recommendation might not convince all researchers, from all fields. However, we hope that the present collaborative work will at least help to prevent the use of "empathy" to refer to any kind of mental state attribution as less ambiguous alternatives are available (e.g. mentalizing about affective states).

Quesque et al., (2024)
https://www.nature.com/articles/s44271-024-00077-6

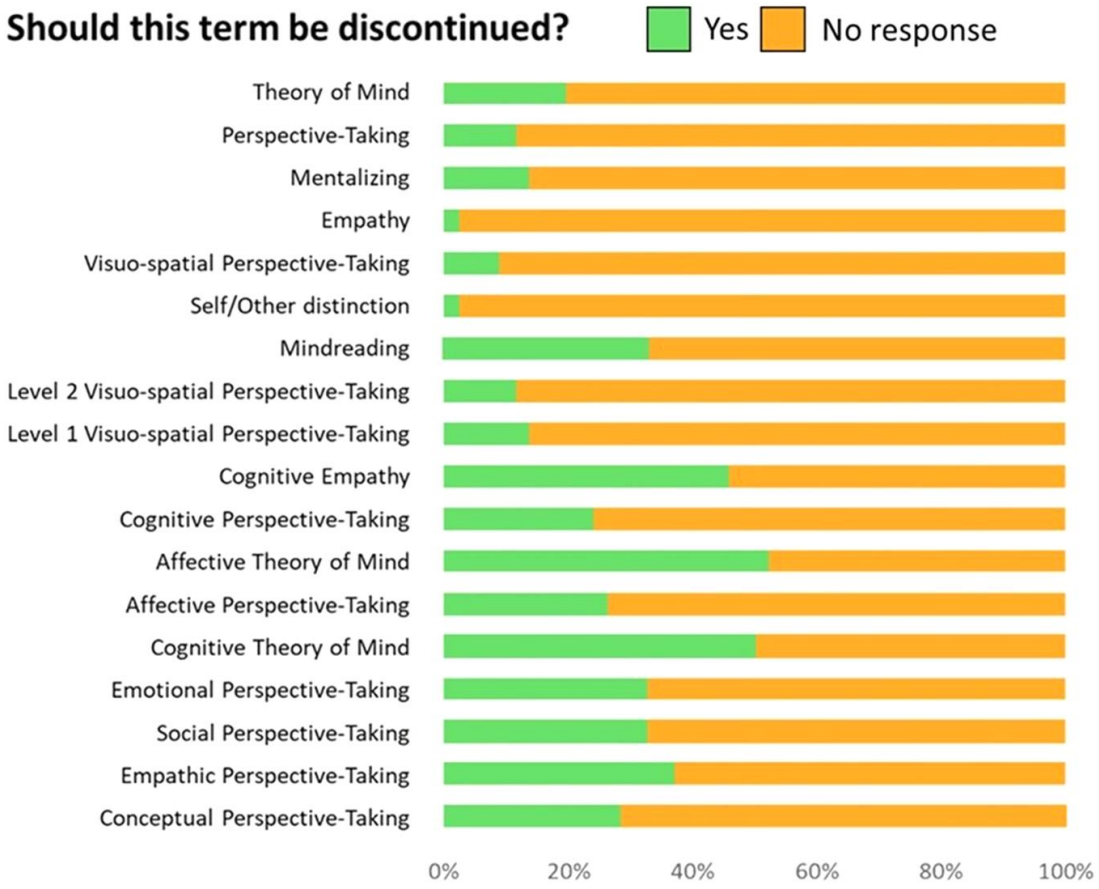
Comment | Open access | Published: 11 April 2024

Defining key concepts for mental state attribution

François Quesque, Ian Apperly, Renée Baillargeon, Simon Baron-Cohen, Cristina Becchio, Harold Bekkering, Daniel Bernstein, Maxime Bertoux, Geoffrey Bird, Henryk Bukowski, Pascal Burgmer, Peter Carruthers, Caroline Catmur, Isabel Dziobek, Nicholas Epley, Thorsten Michael Erle, Chris Frith, Uta Frith, Carl Michael Galang, Vittorio Gallese, Delphine Grynberg, Francesca Happé, Masahiro Hirai, Sara D. Hodges, Philipp Kanske, Mariska Kret, Claus Lamm, Jean Louis Nandrino, Sukhvinder Obhi, Sally Olderbak, Josef Perner, Yves Rossetti, Dana Schneider, Matthias Schurz, Tobias Schuwerk, Natalie Sebanz, Simone Shamay-Tsoory, Giorgia Silani, Shannon Spaulding, Andrew R. Todd, Evan Westra, Dan Zahavi & Marcel Brass — Show fewer authors

Communications Psychology **2**, Article number: 29 (2024) | Cite this article

https://www.nature.com/articles/s44271-024-00077-6



WHAT IS SIMULATION THEORY?

Simulation theory is not strictly a single theory but a collection of theories proposed by various individuals (e.g. Gallese, 2001; Goldman, 2006; Hurley, Clark, & Kiverstein, 2008; Preston & de Waal, 2002). However, common to them all is the basic assumption that we understand other people's behavior by recreating the mental processes on ourselves that, if carried out, would reproduce their behavior. That is, we use our own recreated (or simulated) mental states to understand, and empathically share, the mental state of others. Within this framework there are various ways in which this could occur. Gallagher (2007) broadly distinguishes between two: one could create an explicit, narrative-like simulation of another person's situation and behavior in order to understand it, or when we see someone else's behavior (e.g. their action, emotional expression) we may automatically, and perhaps unconsciously, activate the corresponding circuits for producing this behavior in our own brain. These latter versions of simulation theory tend to be intimately linked to the idea of mirror systems in which perception is tightly coupled with action.

Ward, 2017, page 176

empathy

- an **emotional reaction** to (or **understanding** of) another person's feelings;
- coined by Titchener (1909) from the German word *einfühlung* (Lipps, 1903; *"feeling into"*).

perspective taking

putting oneself in someone else's situation

Theory of Mind vs. Simulation Theory

Historically, explanations of theory of mind have fallen into two camps that are termed **theory-theory** and **simulation theory**.

Theory-theory argues that we **store**, as **explicit knowledge**, a set of principles relating to mental states and how these states govern behaviour (e.g. Gopnik & Wellman, 1992). In this sense, the "theory" in theory of mind is like a **mental rulebook for understanding others**.

This can be contrasted with **simulation theory**, which in one form would argue that **perceptual-motor systems (rather than thinking and theorizing)** are all that is needed for understanding others (e.g. Gallese & Goldman, 1998).

The neuroscience of empathy: progress, pitfalls and promise

Jamil Zaki & Kevin N Ochsner

Nature Neuroscience **15**, 675–680 (2012) | Cite this article

The last decade has witnessed enormous growth in the neuroscience of empathy. Here, we survey research in this domain with an eye toward evaluating its strengths and weaknesses. First, we take stock of the notable progress made by early research in characterizing the neural systems supporting two empathic sub-processes: sharing others' internal states and explicitly considering those states. Second, we describe methodological and conceptual pitfalls into which this work has sometimes fallen, which can limit its validity. These include the use of relatively artificial stimuli that differ qualitatively from the social cues people typically encounter and a lack of focus on the relationship between brain activity and social behavior. Finally, we describe current research trends that are overcoming these pitfalls through simple but important adjustments in focus, and the future promise of empathy research if these trends continue and expand.

https://www.nature.com/articles/nn.3085

Both **theory of mind** and **simulation theory** can be applied to the conceptualization of **empathy**

Assumes a dynamical switching between the two systems, according to the desired outcome, e.g., observing another person in a decontextualized setting may bias towards mirroring.

Cognitive empathy and **affective** empathy

In practice, the extent to which the mirroring/ mentalizing and affective/cognitive distinctions are related or separate remains a matter of debate.

The mirror neuron system

Discovered by accident, in 1992, by a team led by **Giacomo Rizzolatti**, while using **single-cell recordings** in area F5 of the ventral premotor cortex and the inferior parietal lobule.

Exp Brain Res. 1992;91(1):176-80. doi: 10.1007/BF00230027.

Understanding motor events: a neurophysiological study

G di Pellegrino [1], L Fadiga, L Fogassi, V Gallese, G Rizzolatti

Affiliations + expand

PMID: 1301372 DOI: 10.1007/BF00230027

Abstract

Neurons of the rostral part of inferior premotor cortex of the monkey discharge during goal-directed hand movements such as grasping, holding, and tearing. We report here that many of these neurons become active also when the monkey observes specific, meaningful hand movements performed by the experimenters. The effective experimenters' movements include among others placing or retrieving a piece of food from a table, grasping food from another experimenter's hand, and manipulating objects. There is always a clear link between the effective observed movement and that executed by the monkey and, often, only movements of the experimenter identical to those controlled by a given neuron are able to activate it. These findings indicate that premotor neurons can retrieve movements not only on the basis of stimulus characteristics, as previously described, but also on the basis of the meaning of the observed actions.

https://pubmed.ncbi.nlm.nih.gov/1301372/

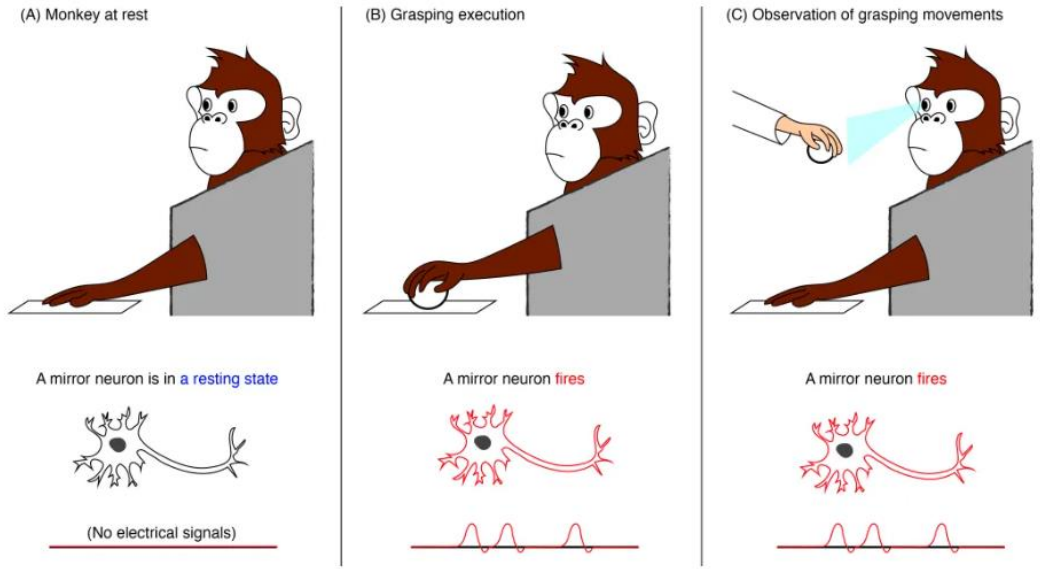


Figure 1: Mirror neurons in action. A mirror neuron fires an electrical pulse, or action potential, when the monkey either observes or executes a specific action. In this case, the mirror neuron responds to grasping actions. The graph at the bottom shows what the action potentials (each depicted as a hump) would look like when measured with an electrode, as used by the researchers.

https://rb.gy/zn2ja

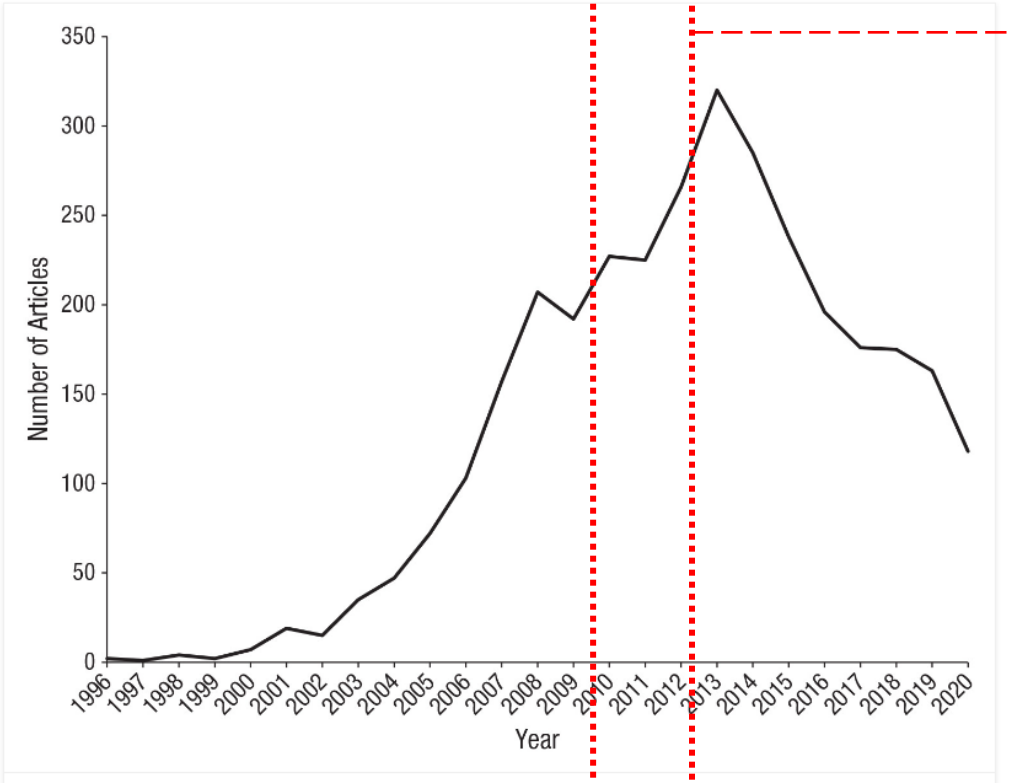


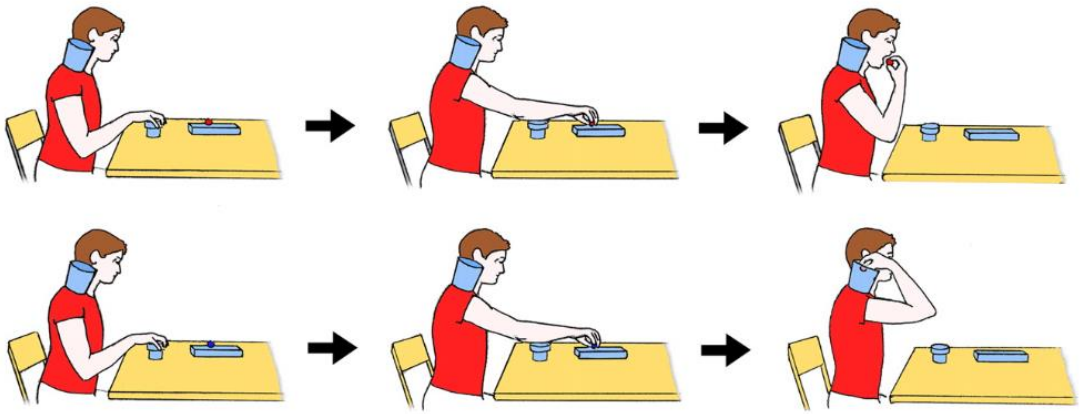
Fig. 1. Number of articles published per year from 1996 to 2020 that included the words "mirror neuron" in the title, abstract, or keywords. Data from Scopus, January 8, 2021.

https://journals.sagepub.com/doi/full/10.1177/1745691621990638

a very young (and naïve) me was an undergrad student in Cluj-Napoca, very passionate about neuroscience and autism

the first autism experiment I tried to do, based on Cattaneo et al. (2007)

Fig. 1.



Schematic representation of the tasks of experiments 1 and 2. (Upper) The individual reaches for a piece of food located on a touch-sensitive plate, grasps it, brings it to the mouth, and finally eats it. (Lower) The individual reaches for a piece of a paper located on the same plate, grasps it, and puts into a container placed on the shoulder.

https://www.pnas.org/doi/10.1073/pnas.0706273104

Impairment of actions chains in autism and its possible role in intention understanding

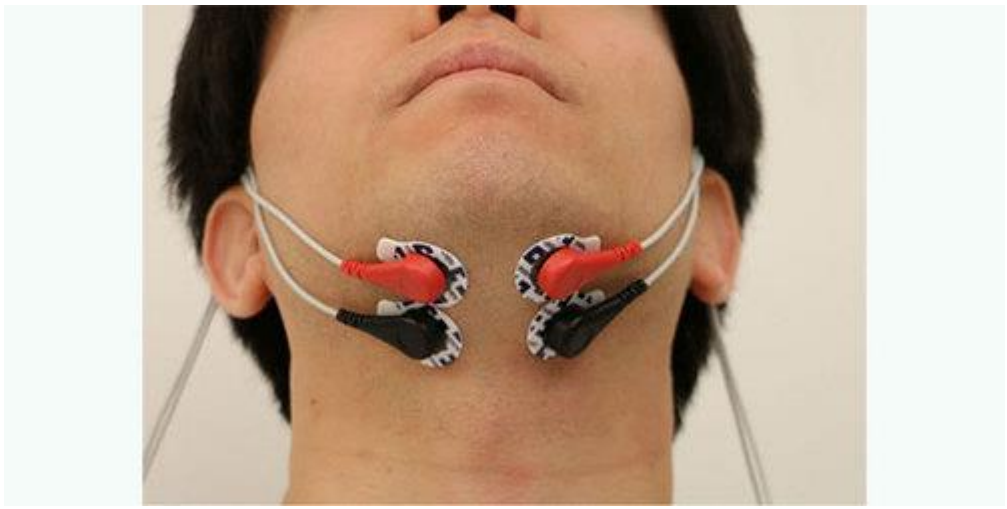
Luigi Cattaneo, Maddalena Fabbri-Destro, Sonia Boria, +3, and Giacomo Rizzolatti Authors Info & Affiliations

Edited by Riitta Hari, Helsinki University of Technology, Espoo, Finland, and approved September 12, 2007

November 6, 2007 | 104 (45) 17825-17830 | https://doi.org/10.1073/pnas.0706273104

Abstract

Experiments in monkeys demonstrated that many parietal and premotor neurons coding a specific motor act (e.g., grasping) show a markedly different activation when this act is part of actions that have different goals (e.g., grasping for eating vs. grasping for placing). Many of these "action-constrained" neurons have mirror properties firing selectively to the observation of the initial motor act of the actions to which they belong motorically. By activating a specific action chain from its very outset, this mechanism allows the observers to have an internal copy of the whole action before its execution, thus enabling them to understand directly the agent's intention. Using electromyographic recordings, we show that a similar chained organization exists in typically developing children, whereas it is impaired in children with autism. We propose that, as a consequence of this functional impairment, high-functioning autistic children may understand the intentions of others cognitively but lack the mechanism for understanding them experientially.



https://www.pnas.org/doi/10.1073/pnas.0706273104

Extensive debate surrounds the function of these neurons and IF they indeed enable mentalizing

Perspect Psychol Sci. 2022 Jan;17(1):153-168. doi: 10.1177/1745691621990638. Epub 2021 Jul 9.

What Happened to Mirror Neurons?

Cecilia Heyes [1] [2], Caroline Catmur [3]

Abstract

Ten years ago, *Perspectives in Psychological Science* published the Mirror Neuron Forum, in which authors debated the role of mirror neurons in action understanding, speech, imitation, and autism and asked whether mirror neurons are acquired through visual-motor learning. Subsequent research on these themes has made significant advances, which should encourage further, more systematic research. For action understanding, multivoxel pattern analysis, patient studies, and brain stimulation suggest that mirror-neuron brain areas contribute to low-level processing of observed actions (e.g., distinguishing types of grip) but not to high-level action interpretation (e.g., inferring actors' intentions). In the area of speech perception, although it remains unclear whether mirror neurons play a specific, causal role in speech perception, there is compelling evidence for the involvement of the motor system in the discrimination of speech in perceptually noisy conditions. For imitation, there is strong evidence from patient, brain-stimulation, and brain-imaging studies that mirror-neuron brain areas play a causal role in copying of body movement topography. In the area of autism, studies using behavioral and neurological measures have tried and failed to find evidence supporting the "broken-mirror theory" of autism. Furthermore, research on the origin of mirror neurons has confirmed the importance of domain-general visual-motor associative learning rather than canalized visual-motor learning, or motor learning alone.

https://pubmed.ncbi.nlm.nih.gov/34241539/

Early research with human participants used functional MRI (fMRI) to show spatial overlap in the areas of ventral premotor cortex and inferior parietal lobule that are active when people observe and execute movements (Buccino et al., 2001; Decety et al., 1997; Grezes & Decety, 2001; Rizzolatti et al., 1996). This was not conclusive evidence of the existence of human mirror neurons because the spatial overlap could have been due not to neurons that each respond both to observation and execution of action (mirror neurons) but to clusters of neurons each responding either to action observation or to action execution (Dinstein, 2008;

A more concrete example of the problems that arise if neural data are used to infer a psychological process comes from the debates regarding the behavioral relevance of "mirror neurons." Mirror neurons, first discovered in the premotor cortex of monkeys, fire whether the monkey itself performs a particular motor goal or observes another individual doing so (di Pellegrino et al., 1992). A huge number of variants of these experiments have been done in both humans and monkeys, but they all have the same general approach: show a common neuronal firing (or fMRI or EEG/MEG activation pattern) when a goal is achieved either in the first person or observed in the third person. Interpretation then has the following logic: as neurons can be decoded for intention in the first person, and these same neurons decoded for the same intention in the third person, then activation of the mirror neurons can be interpreted as meaning that the primate has understood the intention of the primate it is watching. The problem with this attempt to posit an algorithm for "understanding" based on neuronal responses is that no independent behavioral experiment is done to show evidence that any kind of *understanding* is actually occurring, understanding that could then be correlated with the mirror neurons. This is a key error in our view: behavior is used to drive neuronal activity but no either/or behavioral hypothesis is being tested per se. Thus, an interpretation is being mistaken for a result; namely, that the mirror neurons understand the other individual. Additional behavioral evidence that the participant understands the other individual is lacking. This tendency to ascribe psychological properties to single neuron activity that can only be sensibly ascribed to a whole behaving organism is known as the mereological fallacy—a fallacy that we neuroscientists continue to fall for even though we've known about it since Aristotle's *De Anima* (Smit and Hacker, 2014). Thus, what is needed is a better a priori testable framework for behavioral-level understanding that can lead to more thoughtfully designed neurophysiological experiments.

Review > Neuron. 2017 Feb 8;93(3):480-490. doi: 10.1016/j.neuron.2016.12.041.

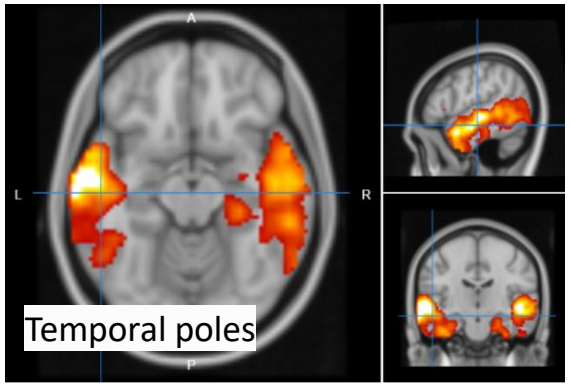
Neuroscience Needs Behavior: Correcting a Reductionist Bias

John W Krakauer [1], Asif A Ghazanfar [2], Alex Gomez-Marin [3], Malcolm A MacIver [4], David Poeppel [5]

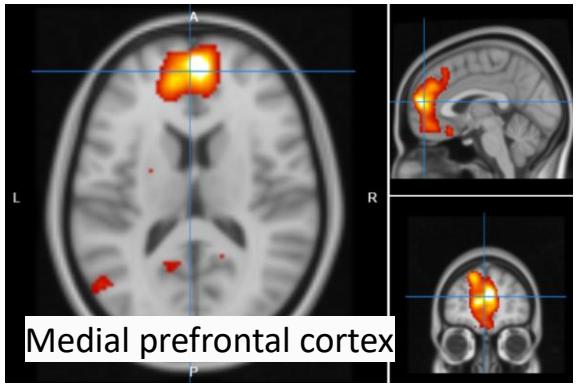
Indeed, to the degree that action understanding has been examined in patients, the evidence does not support a role for the putative mirror neuron mechanism (Hickok, 2009).

https://pubmed.ncbi.nlm.nih.gov/28182904/

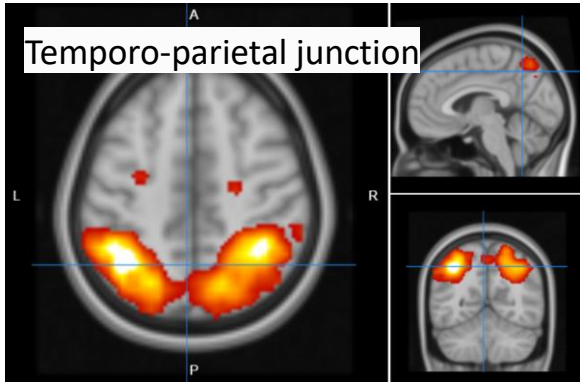
Neural substrates of theory of mind



Temporal poles



Medial prefrontal cortex



Temporo-parietal junction

Clinical Trial > Neuroimage. 2000 Sep;12(3):314-25. doi: 10.1006/nimg.2000.0612.

Movement and mind: a functional imaging study of perception and interpretation of complex intentional movement patterns

F Castelli [1], F Happé, U Frith, C Frith

We report a functional neuroimaging study with positron emission tomography (PET) in which six healthy adult volunteers were scanned while watching silent computer-presented animations. The characters in the animations were simple geometrical shapes whose movement patterns selectively evoked mental state attribution or simple action description. Results showed increased activation in association with mental state attribution in four main regions: medial prefrontal cortex, temporoparietal junction (superior temporal sulcus), basal temporal regions (fusiform gyrus and temporal poles adjacent to the amygdala), and extrastriate cortex (occipital gyrus). Previous imaging studies have implicated these regions in self-monitoring, in the perception of biological motion, and in the attribution of mental states using verbal stimuli or visual depictions of the human form. We suggest that these regions form a network for processing information about intentions, and speculate that the ability to make inferences about other people's mental states evolved from the ability to make inferences about other creatures' actions.

https://pubmed.ncbi.nlm.nih.gov/10944414/

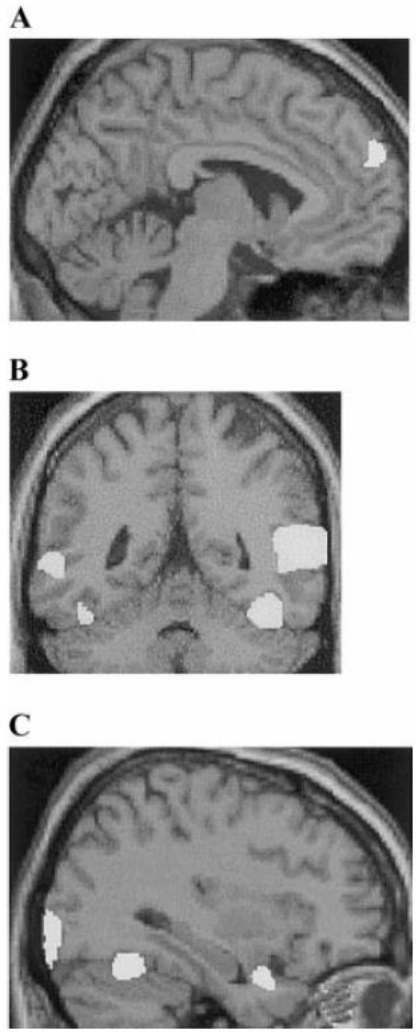
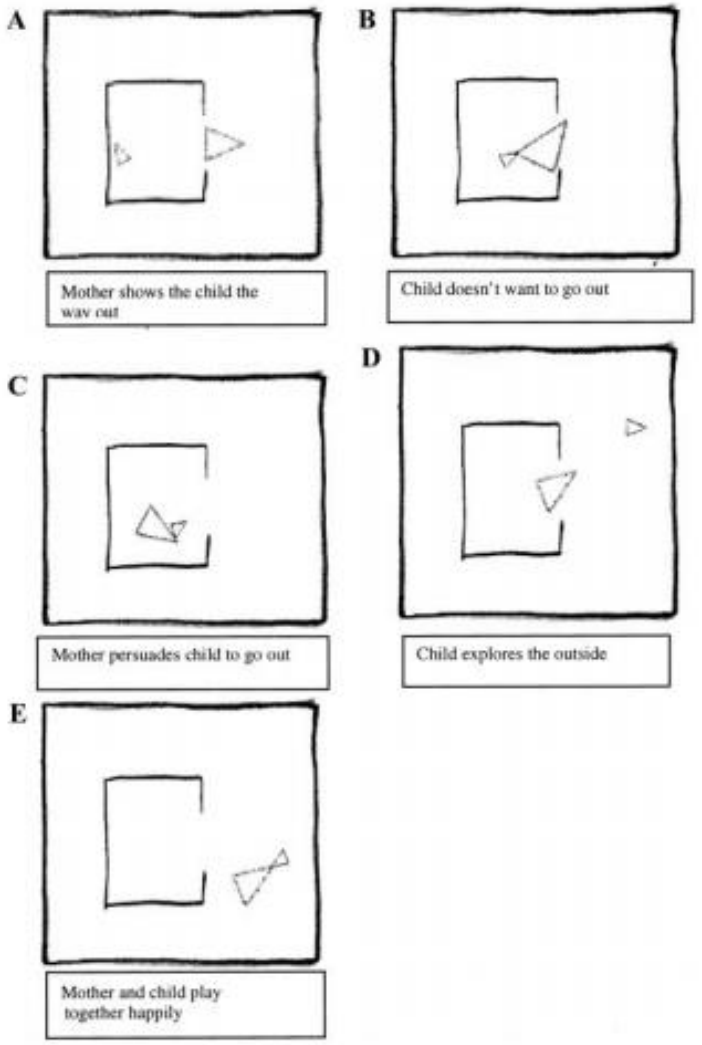


FIG. 2. Regions of significant cerebral blood flow (rCBF) change associated with the perception of ToM animations vs Random animations. (A) Saggital view of activation in superior frontal gyrus. (B) Coronal view of activation in superior temporal sulcus and fusiform gyrus. (C) Saggital view of activation in temporal pole adjacent to the amygdala, fusiform gyrus, and occipital gyrus.

The stills below illustrate a "Theory of Mind" animation. The animation was designed following a script in which Big Triangle is coaxing the reluctant Little Triangle to come out of an enclosure. Subjects were presented with the animations without any suggestion relative to a story or characters' roles. The captions have been added here for clarification.



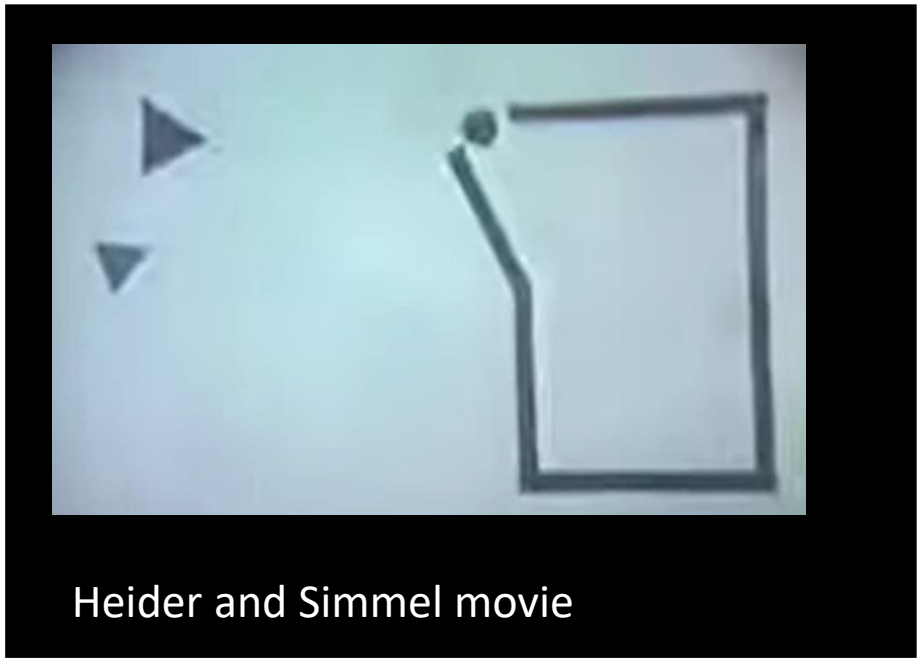
An experimental study of apparent behavior.

Heider, F. Simmel, M.

Citation

Heider, F., & Simmel, M. (1944). An experimental study of apparent behavior. *The American Journal of Psychology, 57*, 243–259. https://doi.org/10.2307/1416950

https://psycnet.apa.org/record/1945-01435-001

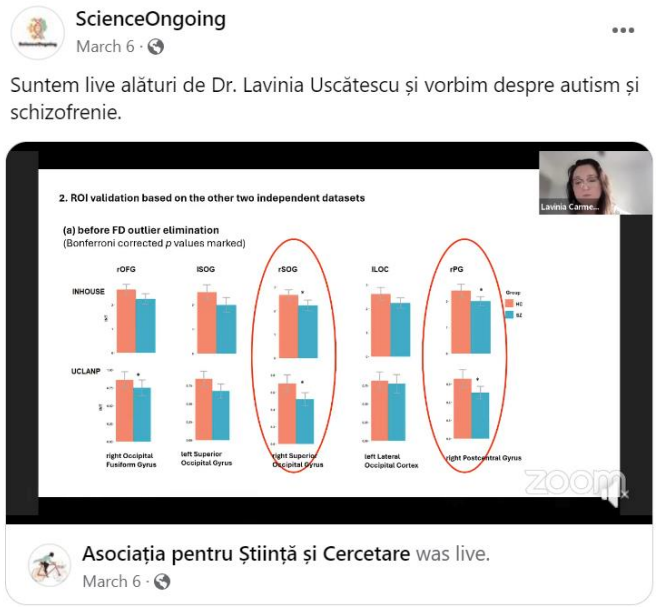


https://www.youtube.com/watch?v=MI4PznE4AxE

Autism

According to the DSM-IV, autistic individuals tend to exhibit **communication difficulty**, such as **responding innadequately in conversations, misreading nonverbal interactions, or having difficulty building friendships appropriate to their age**. In addition, they may be **overly dependent on routine** and **highly sensitive to changes in their environment**.

Autistic traits **fall on a continuum**, with some individuals showing more distinctive features compared to others. DSM-5 Autism Spectrum Disorder Fact Sheet
https://www.psychiatry.org/File%20Library/Psychiatrists/Practice/DSM/APA_DSM-5-Autism-Spectrum-Disorder.pdf



https://www.facebook.com/profile.php?id=61552426919600

Internationally recognised diagnostic criteria for Autism Spectrum Disorder (ASD) are provided in the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5) [1] and the International Classification of Diseases, Eleventh Revision (ICD-11) [2], under a newly included category of "neurodevelopmental disorders," which are lifelong and not episodic mental health conditions. The behaviourally defined criteria continue to be "impairment" or "deficit" focused and diagnostic terms use the language of "disorder," which might be considered to be at odds with social models of disability, realistic medicine, and the neurodiversity paradigm [3].

There is clear evidence that different neurodevelopmental conditions defined as they are currently, usually co-occur and overlap [4] and it is often the combination of individual profile or "neurotype" together with the environment, that determines support needs rather than diagnosis. One consequence of this development in diagnostic criteria, is that it supports the shift in clinical practice, away from a "single condition" focus towards "neurodevelopmental" pathways [5] and a diversification of our approach to assessment, diagnosis, and intervention.

https://www.intechopen.com/books/11588

Elife. 2024 Apr 23:13:e98461. doi: 10.7554/eLife.98461.

Five interdisciplinary tensions and opportunities in neurodiversity research

Olujolagbe Layinka [#1], Luca D Hargitai [#1], Punit Shah [1], Lucy H Waldren [1], Florence Y N Leung [1]

Introduction

Neurodiversity celebrates the inherent complexity of the human mind, highlighting the natural variations that are found within the population. Its higher profile in recent years has led to a greater awareness and more frequent diagnoses of neurodevelopmental conditions, such as autism, attention deficit hyperactivity disorder (ADHD), dyslexia, dyscalculia, dyspraxia and beyond.

Our understanding of these conditions is shaped by findings from a range of research disciplines, including the developmental and social sciences, cognitive neuroscience, psychiatry, education, and the clinical, health and biomedical sciences (notably neurobiology and genetics). Together, these fields aim to uncover the mechanisms and markers underlying neurodevelopmental conditions, from genetic to societal levels of explanation.

However, with so much heterogeneity within neurodevelopmental conditions and across these research domains, it is not surprising that there is a striking dearth of truly interdisciplinary neurodiversity research. This shortfall underscores the overlooked opportunities for the synergy that would come with such work. This article explores five key tensions in the field, and signposts potential opportunities for future progress.

https://pubmed.ncbi.nlm.nih.gov/38652018/

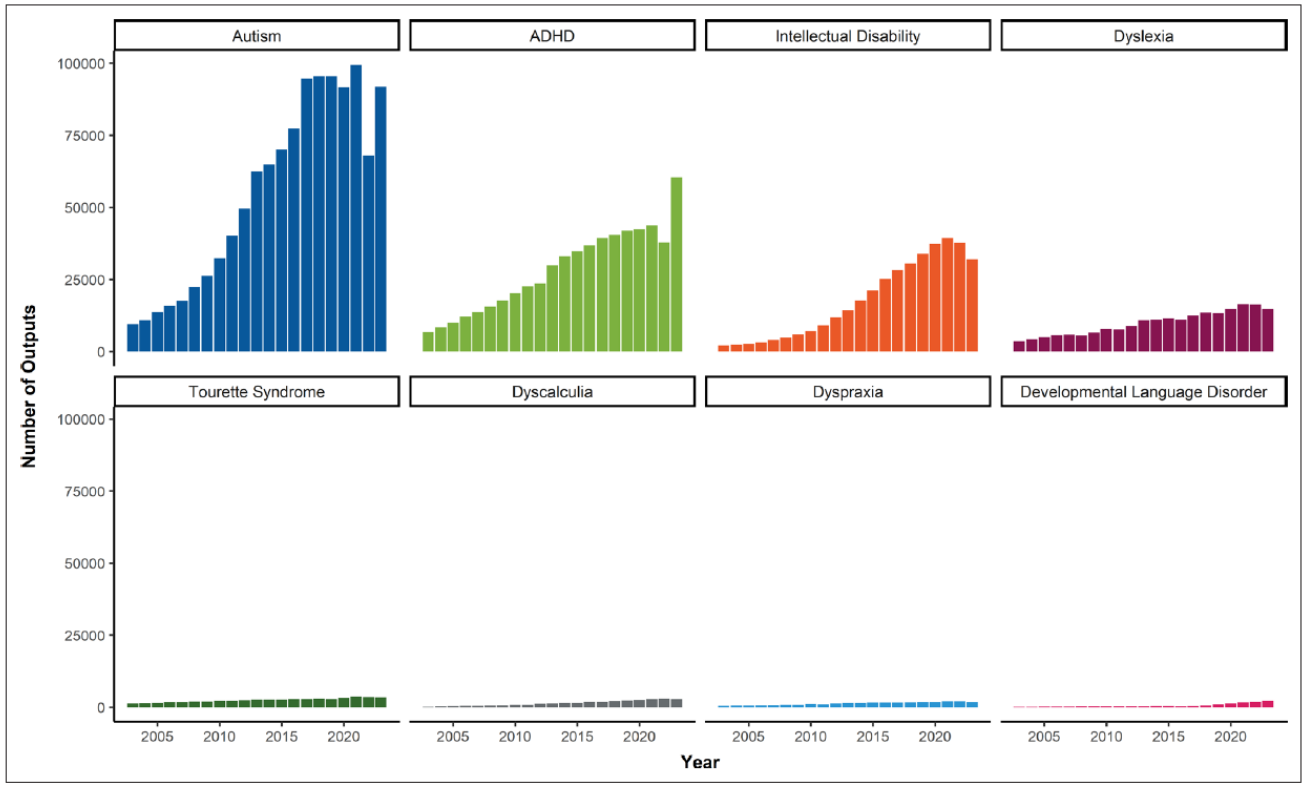
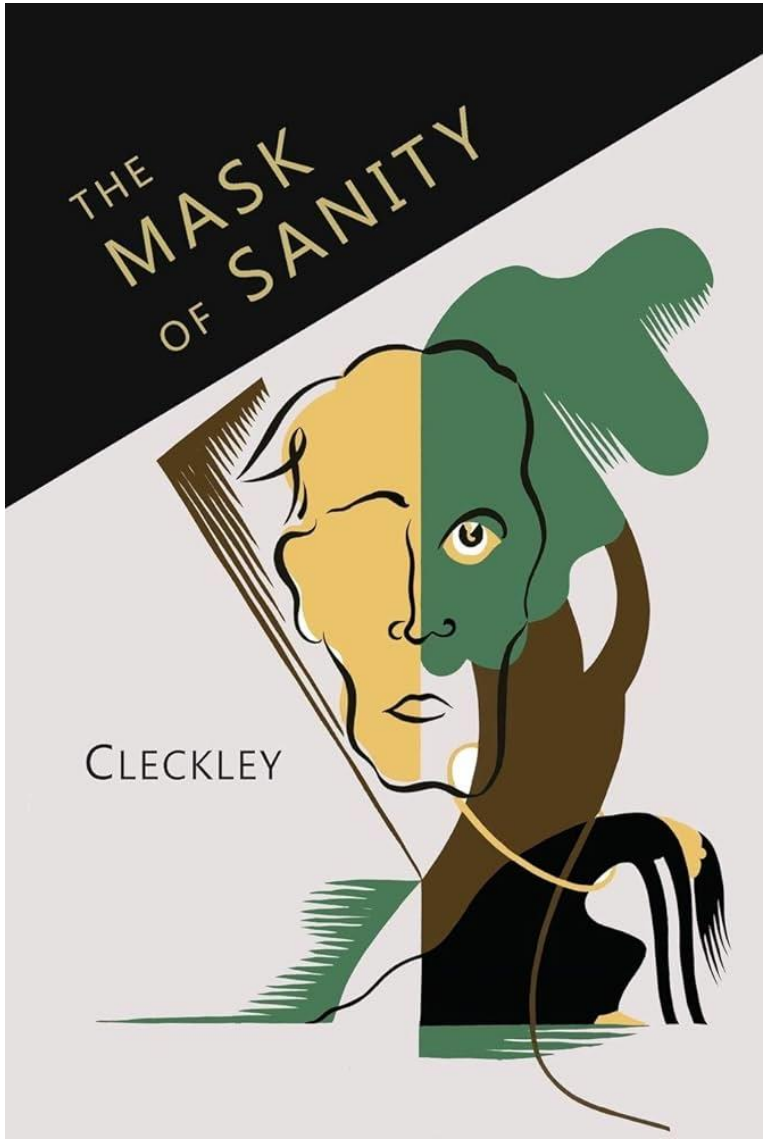


Figure 1. Number of scholarly outputs versus year for eight neurodevelopmental conditions between 2003 and 2023. Data extracted from Google Scholar; the eight conditions are ordered by number of scholarly outputs.

Psychopathy



Harvey Cleckley (1903 – 1984)

His book, *"The Mask of Sanity"*, originally published in 1941, provided the first clinical description of psychopathy.

Psychopathy Checklist—Revised

Hare, R. D. (1991). *Psychopathy Checklist—Revised* [Database record]. APA PsycTests. https://doi.org/10.1037/t01167-000

https://psycnet.apa.org/doiLanding?doi=10.1037%2Ft01167-000

Item 1: Glibness/superficial charm
Item 2: Grandiose sense of self-worth
Item 3: Need for stimulation/proneness to boredom
Item 4: Pathological lying
Item 5: Conning/manipulative
Item 6: Lack of remorse or guilt
Item 7: Shallow affect
Item 8: Callous/lack of empathy
Item 9: Parasitic lifestyle
Item 10: Poor behavioral controls
Item 11: Promiscuous sexual behavior
Item 12: Early behavior problems
Item 13: Lack of realistic long-term goals
Item 14: Impulsivity
Item 15: Irresponsibility
Item 16: Failure to accept responsibility for own actions
Item 17: Many short-term marital relationships
Item 18: Juvenile delinquency
Item 19: Revocation of conditional release
Item 20: Criminal versatility

Robert Hare

Journal of Research in Personality
Volume 109, April 2024, 104450

Full Length Article

Associations of aversive ('dark') traits and affiliative ('light') traits with moral-dilemma judgments: A preregistered exploratory analysis using the CNI model

Nyx L. Ng [a], Craig S. Neumann [b], Dillon M. Luke [a], Bertram Gawronski [a]

Highlights

- Aversive and affiliative traits independently predict moral-dilemma judgments.
- The Dark Tetrad is negatively associated with sensitivity to moral norms.
- The Light Triad is positively associated with sensitivity to moral norms.
- Sadism is positively associated with sensitivity to consequences.
- Sadism is negatively associated with sensitivity to moral norms.

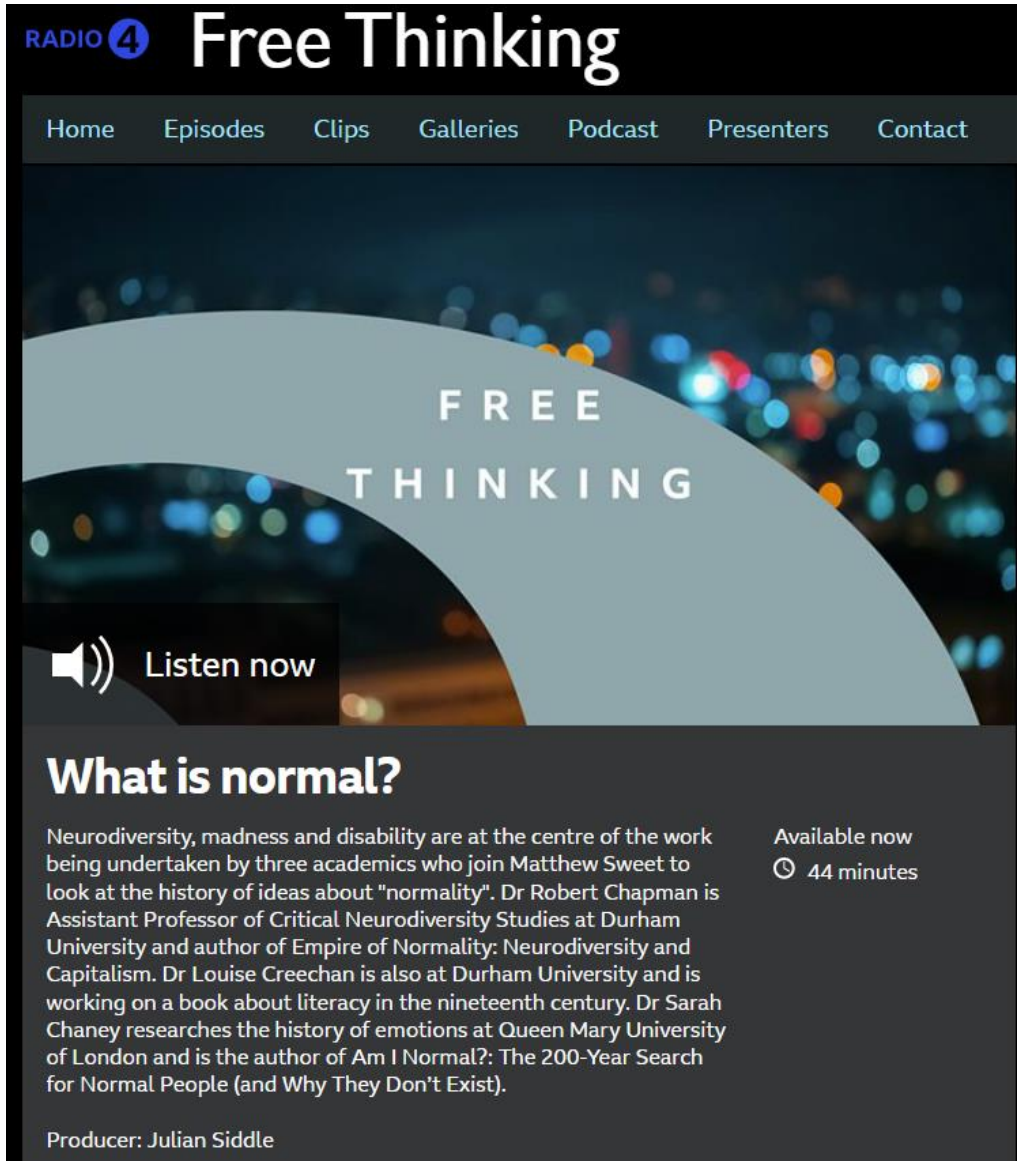
https://www.sciencedirect.com/science/article/pii/S0092656623001125

Abstract

Despite people's capacity for both good and evil, scant research has jointly examined the relations of affiliative and aversive traits with moral-dilemma judgments. Using the CNI model of moral-dilemma judgments, this preregistered exploratory study examined associations of aversive traits (Dark Tetrad comprising Machiavellianism, narcissism, psychopathy, sadism) and affiliative traits (Light Triad comprising Kantianism, humanism, faith in humanity) with sensitivity to consequences (*C*), sensitivity to moral norms (*N*), and general preference for inaction versus action (*I*) in responses to moral dilemmas. Dark Tetrad and Light Triad total scores were negatively and positively associated with sensitivity to moral norms, respectively. Sadism was the only trait-level predictor of moral-dilemma judgments, positively predicting sensitivity to consequences and negatively predicting sensitivity to moral norms.

Psychopathy: The newly developed *Short Dark Tetrad (SD4) & Light Triad Scale (LTS)* (Ng et al., 2024) will be applied to quantify both the aversive traits of psychopathy (i.e., the *Dark Tetrad*) as well as the affiliative traits that counter-act these (i.e., the *Light Triad*). The Dark Tetrad comprises: (1) "Machiavellianism", a penchant for amoral, exploitative, strategic-calculating behavior, (2) "narcissism", an exaggerated sense of grandiosity and superiority coupled with ego-centric, self-promoting behavioral tendencies, (3) "psychopathy", a constellation of affective-interpersonal deficits and impulsive antisocial behavioral tendencies, and (4) "subclinical sadism", a proclivity to hurt others for pleasure or subjugation. The Light Triad comprises: (1) "faith in humanity", belief in the fundamental goodness of mankind, (2) "humanism". valuing the dignity and worth of others, and (3) "Kantianism", treating others as ends unto themselves.

Further resources



https://www.bbc.co.uk/programmes/m001v50n

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